Cross Country Evidence on Consumption Persistence

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Abstract

The detection and measurement of the level of persistence on aggregate and disaggregate private consumption in Italy, Norway and United Kingdom is the main focus of the paper. Using a non-parametric methodology applied to annual data it is concluded that that one cannot reject the presence of a significant process of persistence in aggregate and disaggregate consumption in the three countries, even though each one displaying different levels of persistence. In particular, durables (furnishing and housing & utilities) display a lower degree of persistence when compared with non-durables. These results are imperative from a policy point of view as they may affect the effectiveness of countercyclical fiscal and monetary policies that are currently being implemented to overcome the current economic crisis. Persistence in consumption does exist and cannot be ignored, whether the goal is to stabilize the level of output via consumption or to burst output via long-lasting increases in consumption. Being the case that cultural differences are not easily changed, a possible instrument is the interest rate. Our results do show that a decrease in the interest rates, in order to boost investment, may also lead to non desirables results from the viewpoint of consumption, in particular for the durables categories

Keywords: Consumption, Persistence, Italy, Norway, United Kingdom.

JEL Classification: C14, C22, E21

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1. Introduction and Motivation

The recent world economic and financial crises are been mitigated by a massive fiscal countercyclical stimulus that mainly acts through private consumer spending. The economic rational is well known as well as the (macro) economic reasons why some countries are recovering faster and better than others. However, these (macro) economic relations are not the only ones (or even the most relevant) that determine households' consumption behavior, even in the present economic circumstances. The structure of preferences might be a factor and particularly if and consumers have intertemporally dependent preferences then that may be a reason for consumption to display some sort of persistence or inertia.

The presence of inertia can substantially change the reaction of households to a policy shock or to innovations. This is particularly problematic for the formulation and the effectiveness of the present countercyclical policies that act through consumption. Persistence can reduce the incidence, the length, and the severity of shocks and of changes of the economic conditions. Furthermore, measuring the response of consumption to a shock is also important because it may show at what time is more essential to act in order to overwhelm a harmful effect of a shock.

Traditionally, macroeconomic policies play the dominant role in smoothing the business cycle but the effectiveness of those policies depends upon the economy's resilience. That is, the success of those policies depends upon the ability of the economic system to absorb the shock and to return to the baseline. Therefore, given the presence of persistence in consumption, the key question is whether it is viable and effective to design countercyclical policies that act through consumption expenditures.

The literature on the importance of persistence in macroeconomics is inexplicably insufficient. The first macroeconomic studies incorporating the issue of persistence appeared only at the early 1980s and only recently a factual interest in the phenomenon came about. The importance and the need to (theoretically and empirically) study the phenomenon are further strengthened by the current economic and financial crisis, where the persistence of the recession is a central issue. In addition, the literature on the persistence of consumer habits has recently also gained some relevance in the psychology and marketing.

The first studies that explicitly considered the importance of persistence were of macroeconomic nature and begun by highlighting the role of both staggered wage-setting and

staggered price-setting as a source of persistent real effects of monetary shocks (see, for instance, Taylor, 1980; Rotemberg & Woodford, 1997; Huang & Liu, 2002).[1] On the other hand, given the alleged inability of standard real business cycle models to reproduce the evolution of output shown in real world conditions (Cogley & Nason, 1995) the inertial hypothesis was also used to explain the (strong) persistence of output that could be observed in reality (see, among others, Bouakez & Kano, 2006; and Maury & Tripier, 2003). However, this response did not close the debate, in which the possibility of monetary policy shocks affecting aggregate output is central. Indeed the persistence of shocks to aggregate output has been, still is (and most probably it will be for some time) one of the issues predominantly subject to examination.

For the empirical evidence that monetary policy shocks can have permanent effects on aggregate output (or unemployment) there have been proposed some theoretical explanations, notably imperfect information and short-run nominal price stickiness (see, for example, Kiley, 2000; and Wang & Wen, 2006). Furthermore, Jonsson (1997), Lockwood (1997) and Svensson (1997), analyzed the consequences to output or unemployment persistence due to the establishment of inflation contracts. All these studies share the idea that whether or not price rigidity is responsible for output or unemployment persistence, this should be seen as an empirical issue rather than a theoretical one.

Another interesting consequence of output persistence is that it may turn upside down the political business cycle which, in its typical form, is associated with depressions at the beginning of the mandate followed by pre-election inflationary expansions (see, for example, Gärtner, 1996,1999; as well as Caleiro, 2009). Quite recently, it was registered an increase of interest in analyzing the persistence of output, as well as of inflation, considering its relationship with the degree of openness of the economies (Guender, 2006), the exchange-rate regime (Giugale & Korobow, 2000) or the structural change on the preferences of consumers, firms or policy-makers.

Despite the absence of microeconomic foundations for macroeconomic persistence, the literature on intertemporally dependent preferences is a well-built theoretical basis for inertial behaviour and therefore, to persistence. Indeed, in a seminal work, Dusenberry (1949) called the attention for the importance of past consumption on the current consumption level of households. Ryder & Heal (1973) and Constantinidies (1990) showed that when instantaneous well-being is determined by both the current (the level effect) and past (the habit or persistence effect) level of consumption throughout a process of 'learning-by-consuming', the intertemporal dependent preferences might be a reason to cause a permanent cyclical behavior of consumption along its

[1] See also Ascari (2003) for a critic of the real role of staggered wage-setting and staggered price-setting as sources of inertia.

time path. This hypothesis, built upon the importance of habits, has also been tentatively used to explain the behaviour of the growth rate and of the savings rate during a recession (Carroll, 2000; Wendner, 2000). Moreover, Belbute & Brito (2008) show that the presence of the inertial effect can not only lower the long run equilibrium level of natural capital and the growth rate of the economy, but also reduce the effectiveness of an environmental policy that is meant to improve environmental quality as well as sustainability.

In addition, the literature, in the fields of psychology and marketing, on the persistence of consumer, habits has gained relevance but, to the best of our knowledge, was not yet connected with the one mentioned above. Belbute & Caleiro (2009) may be viewed as a first step on the way how the behavior of consumers in a country with specific psycho-social habits of consumptions may lead to some persistence on consumption at an aggregate level.

The goal of our paper is to contribute for the design of public countercyclical policies that act through private aggregate and disaggregate consumption in order maximize their effectiveness. We do so by measuring the degree of persistence associated to private consumption (by type) for Italy, United Kingdom and Norway. This allows us to highlight the influence that cultural differences (Latin, Anglo-Saxon and Nordic) may have on the measure of persistence, as a recent approach indicates to be relevant.

Our paper extends the literature by measuring the degree of private consumption persistence using two different approaches depending whether the corresponding time series have stationary or no-stationary behaviour. In the first case, persistence is measured by estimating the sum of the auto-regressive coefficients of the appropriate autoregressive models. However, when the null hypothesis of a unit root cannot be rejected, persistence cannot be measured by the standard time series analysis. By definition, when the time series has no-stationary behavior it does not revert to its mean and thus it does not exhibit inertial behavior. In this case we will measure persistence by using a non-parametric methodology proposed by Marques (2004).

Our results show that we cannot reject the presence of a significant process of persistence in aggregate and disaggregate consumption in the three countries, even though each one displaying different levels of persistence. Furthermore, the degree of persistence is even different when we consider disaggregate private consumption. In particular, durables (furnishing and housing & utilities) display a lower degree of persistence when compared with non-durables. This is line with the different nature of these two categories of expenses. With durable goods, spending and "consumption" (consumption services and enjoyment) does not occur simultaneously. Spending occurs in one moment and is reflected in data whereas consumption is staggered and it is not

included in data. Like investment goods, durables have a more distinct pro-cyclical behavior than non durables. Plainly, these results are imperative from a policy point of view. First of all, persistence in consumption does exist and cannot be ignored, whether the goal is to stabilize the level of output via consumption or to burst output via long-lasting increases in consumption.

The paper is organized as follows: In Section 2 a theoretical model of optimal consumption leading to persistence is presented. Section 3 offers some methodological notes about persistence. Section 4 presents the data. Section 5 is occupied with the empirical results, put in confrontation with the expected results from the model in section 2. Section 6 concludes.

2. A model of consumption persistence

Let us consider a consumer that possesses an instantaneous utility function defined to be $U_t = ln(c_t)$, where c_t denotes the level of consumption on moment t. As usual, let us assume that the consumer consumes until moment 2, such that his/her objective function is:

$$U = \sum_{t=0}^{2} \beta^t ln(c_t) \qquad (1)$$

where β is the discount factor.

To support the consumption expenditures, the consumer has some monetary resources, which, if not spent, can be capitalized at an interest rate *r*. This means that the maximization of (1) must consider the inter-temporal restrictions

$$a_{t+1} = (1 + r)a_t - c_t \qquad (2)$$

for $t = 0, 1, 2$ where $a_0 = \bar{a}_0$ denotes the initial level of (monetary) resources.[2]

For the moment let us apparently ignore the existence of persistence on consumption, being understood as the influence of last consumption, say γc_{t-1} on current consumption, c_t. The higher γ, the greater the influence of past consumption experiences over current level of consumption and thus the greater the degree of persistence. Under these circumstances, it is straightforward to show that the optimal levels of consumption will be given by

[2] Plainly, given the time horizon of the consumer, it makes no sense not to spend all the resources on the last period, therefore $a_3 = 0$, which means $c_2 = (1 + r)a_2$.

$$c_0 = \frac{(1+r)}{1+\beta+\beta^2}\bar{a}_0; \quad c_0 = \beta\frac{(1+r)^2}{1+\beta+\beta^2}\bar{a}_0, \quad c_0 = \beta^2\frac{(1+r)^3}{1+\beta+\beta^2}\bar{a}_0$$

From these expressions it is easy to see that the relationship between present and past consumption level is given by

$$c_t = \beta(1+r)c_{t-1} \tag{3}$$

Plainly, this shows that the persistence on consumption is present and should be always considered. As a matter of fact, one can consider that the above problem can be restated in terms of the determination of the optimal level of persistence on consumption, γ, which is given by

$$\delta = \beta(1+r) \tag{4}$$

Clearly, for a given interest rate, the optimal level of persistence increases the more the consumer cares about the future. This has obvious implications as: (a) it has to do with the time horizon of consumers, therefore making it possible to differ in accordance to the characteristics of different cultures; (b) it has to do with the durability (or not) of the consumption goods, therefore making it possible to differ in accordance to the characteristics of the different goods.

3. Persistence: definitions and methodological notes

Persistence can be broadly defined as the speed with which a variable, say, consumption, returns to its baseline (or its previous level) after, say, a shock (for instance, a macroeconomic policy measure) or an 'innovation'. In other words, consumption is said to be the more inertial the slower it converges (or returns) to its previous level, after the occurrence of a stimulus. The implication of this definition is that the degree of persistence can be associated with the speed with which consumption responds to a shock and with the length (permanent or temporary) of the shock effects. When the value is small, consumption responds quickly to a shock and tends to stay more time away from its trend. Conversely, when the value is high, the speed of adjustment by consumption is low and it will tend to return more quickly to its baseline.[3] In other words, consumption is said to be the more persistent the slower it converges or returns to its previous level, after the occurrence of a shock. Persistence is, thus, inversely related with the concept of mean reversion.

[3] Given that the persistence is a long-run effect of a shock or innovation, the concept is intimately linked to the impulse response function associated to autoregressive models which actually is not a useful measure of persistence given its infinite length.

Quantifying the response of consumption to a shock is indeed important not only because it may allow assessing the effectiveness of economic policy measures but also because it may show at what time is more appropriate to act in order to overwhelm a harmful effect of a shock over consumption. By definition, quantifying the response of consumption to shocks implies evaluating the persistence of consumption.

Some authors have proposed to obtain those estimates by the use of *autoregressive model* as the estimates of persistence at time *t* will express how long we expect that a shock to a magnitude will take to die off (if ever), given present and *past* level of the variable, a univariate AR(k) process is characterised by the following expression:

$$y_t = \alpha + \sum_{j=1}^{k} \beta_j y_{t-j} + \varepsilon_t \tag{5}$$

where y_t denotes the aggregate and disaggregate private consumption at moment *t*, which is explained by a constant α, by past values up to lag *k*, as well as by a number of other factors, whose effect is captured by the random term $\varepsilon_{i,t}$. Alternatively, (5) can also be reparameterized as follows:

$$\Delta y_t = \alpha + \sum_{j=1}^{k-1} \delta_j \Delta y_{t-j} + (\rho - 1) y_{t-1} + \varepsilon_t \tag{6}$$

where

$$\rho = \sum_{j=1}^{k} \beta_j \tag{7}$$

is the "sum of the auto-regressive coefficients" and $\delta_j = -\sum_{i=j+1}^{k} \beta_i$

Again, the AR(k) process (5) (or (6)) can also be reparameterized and written as

$$(y_t - \mu) = \sum_{j=1}^{p-1} \delta_j \Delta(y_{t-j} - \mu) + \rho(y_{t-1} - \mu) + \varepsilon_t \tag{8}$$

or equivalently

$$\Delta y_t = \sum_{j=1}^{p-1} \delta_j \Delta(y_{t-j} - \mu) + (\rho - 1)(y_{t-1} - \mu) + \varepsilon_t \tag{9}$$

with

$$\mu = \frac{\alpha}{1-\rho} \tag{10}$$

being the "unconditional mean" of y_t series.

This formulation has the advantage to show that persistence is related with the concept of "mean reversion", present in equation (8) or (9) by the term by $(\rho - 1)(y_{t-1} - \mu)$. As long as $(\rho - 1) < 0$ (or alternatively, $(\rho < 1)$)[4], any unit deviation from the mean in period t-1, $(y_{t-1} - \mu)$, will force the series in the next period to a (positive or negative) change in the series in the subsequent period by the amount $(\rho - 1)$ and, thus, bringing it close to the mean[5]. Andrews & Chen (1994) proposed the "sum of the autoregressive coefficients" (7) as a measure of persistence.[6] The rationale for this measure comes from the fact that for $|\rho| < 1$, the cumulative effect of a shock on y_j is given by $\frac{1}{1-\rho}$.

One important implication of stationary autoregressive processes (that is, $\rho < 1$) is that any shock have transitory effects whereas under the autoregressive unit roots (or non-stationary) hypothesis (that is $\rho = 1$), random shocks have a permanent effect on the system. That is, fluctuations are not transitory, and there is no tendency of the system to return to a stable value.

Unfortunately, the procedure described above is inappropriate when data series is a "non stationary" process, that is series that once moved way from its mean do not reveal tendency to return to it. The existence of a unit root in the data generation process makes it impossible to accept the results from a traditional OLS estimation.

Marques (2004) has suggested a non-parametric measure of persistence, γ, based on the relationship between persistence and mean reversion. In particular, Marques (2004) suggested using the statistic:

$$\gamma = 1 - \frac{n}{T} \tag{11}$$

[4] In this case the time series is said to be stationary or equivalently, it does not have an auto-regressive "unit root".
[5] By definition, a unit root process does not exhibit this property of mean reversion.
[6] Authors have, indeed, proposed other alternative measures of persistence, such as the largest autoregressive root, the spectrum at zero frequency, or the so called half-life. For a technical appraisal of these other measures see, for instance, Marques (2004) and Dias & Marques (2004).

where *n* stands for the number of times the series crosses the mean during a time interval with *T* + 1 observations,[7] to measure the absence of mean reversion of a given series, given that it may be seen as the unconditional probability of that given series not crossing its mean in period *t*.

As Dias & Marques (2005) have shown, there is a one-to-one correspondence between the sum of autoregressive coefficients, ρ, given by (7) and the non-parametric measure, γ, given by (11), when the data is generated by an AR(1) process, but such a one-to-one correspondence ceases to exist once higher order autoregressive processes are considered. In other words, only in the particular case of a first-order autoregressive model, AR(1), either one of the two measures can be used to quantify the level of persistence, as both transmit the same result. But as soon as higher order autoregressive models are considered, *i.e.*, AR(*k*) with $k \geq 2$, the monotonic relationship between ρ and γ no longer exists, therefore leading to possibly crucial differences when measuring persistence in the series.

Expressions (8) or (9) are also useful because they help to understand the importance of the "mean" and in particular what mean should one use to measure persistence. Clearly, in order to compute the estimative of persistence for each kind of consumption, the mean of each series has to be computed and assumptions must be made about its behaviour over time. As suggested in Marques (2004), a time varying mean is more appropriate than the simple average for all the period under investigation.

One possibility is to consider that the mean follows a linear deterministic trend given by $\mu_t = \bar{\mu} + \delta t + \varepsilon_t$ (with ε_t being a white noise process) and use the detrended time series to measure persistence as in (3). But, again, this method is only viable when time series is a stationary process and residuals are a white noise process.

Using the alternative measure of persistence, γ, given by (11), has also advantages (Dias & Marques, 2005)[8] as it does not impose the need to assume a particular specification for the data generation process, therefore does not require a model for the series under investigation to be specified and estimated.[9] This is so given that γ is indeed extracting all the information about the persistence from the data itself. As it measures how often the series reverts to its means and (high/low) persistence means that, after a shock, the series *reverts* to (or *crosses*) its means more (seldom/frequently), one does not need to specify a particular form for the data generation

[7] The ratio *n/T* gives the degree of mean reversion.
[8] The statistical properties of *γ* are extensively analysed in Marques (2004) and Dias & Marques (2005).
[9] In technical terms, this means that the measure is expected to be robust against potential model misspecifications and given its non-parametric nature also against outliers in the data.

process. To put differently, the less a time series cut its mean, the greater will be the degree of persistence and thus the higher the value of γ.

4. Data and preliminary data analysis

This section describes the basic data set, presents the results of the unit root tests, and discusses the implications of the non-stationary nature of data for persistence.

4.1 A brief description of data set

We use annual data for the period 1977 to 2003 for both aggregate and disaggregated private consumption for Italy (1970 to 2007), United Kingdom (1963 to 2008) and Norway (1980 to 2006). Because these sample periods include years before and after integration the European Economic Community and the EuroZone, we consider throughout the empirical analysis the possibility of a structural break in 1973 for United Kingdom (integration in EEC) and 1999 for Italy (entrance in the euro zone). Furthermore, we also considered the possibility of structural breaks in 1992/1993 for Italy and United Kingdom due to their decisions to abandon the European Monetary System in August 1992.

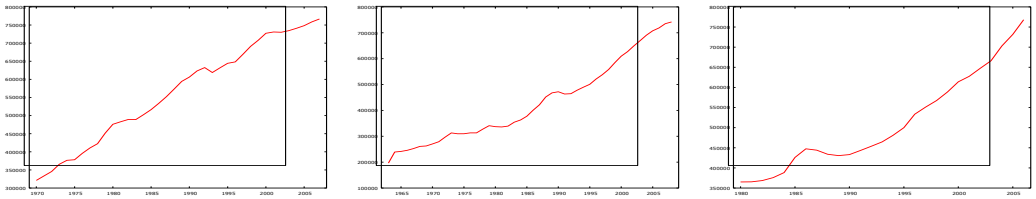
Data for aggregate and disaggregate private consumption for each country was obtained from Eurostat which classifies household consumption expenditure by consumption purpose according to the COICOP classification - Classification Of Individual Consumption by Purpose (see Commission Regulation 113/2002 of 23 January 2002). Aggregate private consumption is defined as the sum of private consumption for the twelve categories at two-digit level shown in table 1.

Each one of these 12 categories includes households' expenses that can be aggregated into four one-digit level groups: services, non-durables, semi-durables and durables. For example, expenses with "housing" includes "services" (actual rentals paid by tenants including other actual rentals, services for the maintenance and repair of the dwelling, refuse and sewerage collection, etc) as well as non-durables such as materials for the maintenance and repair of the dwelling, water supply, electricity, liquid and solid fuels, gas, heat energy, etc. On the other hand "Transport", for example, includes services (maintenance and repair of personal transport equipment), semi-durables (spare parts and accessories for personal transport equipment), and durables (motor cars, motor cycles, bicycles, etc). For this reason it is not possible to make any direct association between the two categories. In particular, it not possible to have a precise outlook about these four

aggregate households expenses using the three-digit variables. This prevents us to measure persistence of these four important categories of household expenses.

Moreover, the sum of autocorrelation coefficient will only be estimated for aggregate private consumption of each country. The disaggregated measure of persistence is obtained using the cyclical component extracted by the Hodrick-Prescott filter (HP-Filter, hereafter) for the first nine categories of table 1, which represents an average of 73.49 % of total private consumption. Figures 1 plots the aggregate consumption expenditures for the three countries.

Figure 1 - Aggregate private consumption for Italy (panel a)), United Kingdom (panel b)) and Norway (panel c))



a) b) c)

Table 1: Structure of private consumption

Country	Period	Food and non-alcoholic beverages	Clothing and footwear	Housing, water, electricity, gas and other fuels	Furnishings, household equipment and routine maintenance of the house	Health	Transport	Communications	Education	Alcoholic beverages, tobacco and narcotics	Recreation and culture	Restaurants and hotels	Miscellaneous goods and services
Italy	Overall Sample	18.2%	3.5%	9.1%	19.7%	7.9%	2.5%	12.3%	1.7%	0.8%	6.3%	9.1%	8.9%
	1970-1993	19.9%	4.1%	9.4%	20.1%	7.7%	1.9%	11.6%	1.0%	0.8%	5.9%	9.1%	8.5%
	1994-2008	15.2%	2.5%	8.7%	18.9%	8.2%	3.5%	13.6%	2.7%	0.9%	7.0%	9.2%	9.5%
United Kingdom	Overall Sample	12.2%	7.0%	4.9%	22.0%	5.4%	1.8%	14.5%	1.4%	1.3%	6.0%	12.4%	11.0%
	1963-1973	16.0%	10.4%	4.2%	25.4%	5.4%	1.8%	12.7%	0.7%	1.2%	0.9%	12.5%	8.8%
	1974-1993	12.2%	7.4%	4.3%	23.3%	5.1%	1.9%	15.0%	1.1%	1.4%	4.6%	13.4%	10.5%
	1994-2008	9.4%	4.1%	6.3%	17.7%	5.8%	1.6%	15.2%	2.2%	1.4%	11.8%	11.1%	13.5%
Norway	Overall Sample	16.0%	5.9%	5.7%	21.7%	6.0%	2.6%	15.7%	1.5%	0.5%	11.3%	5.6%	7.6%
	1980-1987	17.7%	7.1%	5.5%	23.0%	6.0%	2.1%	18.0%	0.6%	0.5%	8.5%	4.9%	6.0%
	1988-1994	16.4%	6.5%	5.2%	24.0%	5.7%	2.8%	14.5%	0.9%	0.6%	9.7%	5.6%	8.0%
	1995-2006	14.7%	4.6%	6.1%	19.5%	6.1%	2.7%	14.7%	2.5%	0.5%	14.0%	6.1%	8.5%

Clearly, “Food and non-alcoholic beverages” (Food, hereafter), “Furnishing, household equipment and routine maintenance of the house” (Furnishing, hereafter) and “Communications” are the three most important components of aggregate consumption. Together they represent almost 50% of all private consumption but in recent years these group of private consumption items have consistently reduced its relevance. However, the relative importance of these groups of items is different across each country, with Norway being the country where these items have more weight. On the other hand, we also detect differences across these countries when we consider each item. For United Kingdom, Food has less weight than for the other two countries.

4.2 Testing stationary

We test the unit roots hypothesis for aggregate and disaggregate private consumption data for Italy, United Kingdom and Norway by using the modified Dickey–Fuller t test (also known as the Dickey–Fuller Generalized Least Squares test (DF-GLS) proposed by Elliott et al. (1996). Essentially,

the df-gls test is an augmented Dickey–Fuller test where the time series is transformed via a (GLS) regression before performing the test. Elliott et al. (1996) and later studies have shown that this test has significantly greater power than the previous versions of the augmented Dickey–Fuller test. The AD-GLS t- test suggest that the null hypothesis of a unit root cannot be rejected for all variables at the 5% significance level (see tables 1A, 2A and 3A in appendix).

One major problem with unit roots test is the implicit assumption that deterministic trend is well determined. But, as Perron (1989) argued, if there is a break in the deterministic component of the time series, then unit root tests will lead to misleading conclusions about the presence or absence of a unit root.

The literature on trend breaks in unit roots is vast and sometimes controversial but converges to the need to test the null hypothesis of a unit root with a possible known and/or unknown broken series. In our empirical analysis below we fully consider the possibility of both known and unknown structural breaks only for aggregate consumption for the three countries. The known break is 1992 for Italy and United Kingdom and is consistent with the decision of these two countries to leave the European Monetary System (EMS) in the summer of 1993. We also use the Chow (1960) test to investigate for unknown test breaks.

In both cases, we follow the Perron (1989)'s strategies to test the null hypothesis that the time series have a unit root with a possibly nonzero constant against the alternative that the process is "trend-stationary". Furthermore, we also investigate the presence of two unknown "outliers" by using the Clemente et al. (1998)'s strategy.[10] Table 4A in appendix summarizes the results for the cases where the null hypothesis of a unit rote process could not be rejected.

5. The level of persistence of the private consumption

This section measures the level of persistence of aggregate and disaggregates private consumption for Italy, United Kingdom and Norway. A simple visual inspection of the graphs of all time series sample suggests that the measurement of the level of persistence should be performed under a time varying mean framework. We will measure persistence using two distinct methodologies. First, for the trend-stationary cases the residuals of the regressions of models B, C and Clemente et al. (1998) in table 4A (that is, the deviations from the mean of each type of energy demand) are used to compute the degree of persistence (or the sum of the autoregressive coefficients, ρ). Secondly, the level of persistence for the aggregate and disaggregate demand of energy is

[10] Formally, a structural break is a special case of an "outlier". An "outlier" has the general property of causing a change on the level of the time series. This change can take effect instantaneously (and the outlier is said to bes "additive" (AO) or the change is supposed to affect the level of the series gradually (and the outlier is said to be "innovative" (IO). In this paper we use the Innovative Outlier case. For further references see, for example Perron & Vogelsan (1992).

measured by using the non-parametric strategy statistic (7) proposed by Marques (2004) to the residuals of the regressions of models B, C and Clemente et al. (1998) in table 4A and to the cyclical component extracted with the Hodrick-Prescott filter . In both cases we compute the overall period and corresponding sub-periods degree of persistence and perform a simple test on the statistical significance of the estimated level of persistence.

5.1 A parametric measure of the degree of persistence

The parametric level of persistence for each country is estimated for aggregate private consumption of each country and for the overall sample period and the identified sub-periods and only for the stationary cases. The sum of the auto-regressive coefficients $\hat{\rho}$ is estimated by the following regression.

$$\epsilon_t = \sum_{j=1}^{p-1} \delta_j \Delta\varepsilon_{t-j} + \rho_{t-1} + \varepsilon_t \qquad (12)$$

where ϵ_t are the residuals of models B, C and Clemente et al. (1998), presented in table 4A in the Appendix.

Results suggest a high degree of persistence of private aggregate consumption in United Kingdom but for Italy and Norway the results depend upon the break point considered.

Table 2 - Persistence of private aggregate consumption

COUNTRIES	Break Points		Overall Sample				
	T_B	Method	T	Lags	ρ	t_ρ	*p-Value*
Italy	1992	Chow - Perron (1989), Model B	38	2	0.728	6.996	0.0000
	1995		38	2	0.510	3.925	0.0000
United Kingdom	1980	Chow - Perron (1989), Model C	46	1	0.790	8.807	0.0000
	1992	Chow - Perron (1989), Model C	46	1	0.784	10.750	0.0000
	1995		46	1	0.776	10.240	0.0000
Norway	1987	Chow - Perron (1989), Model B	27	0	0.791	6.816	0.0000
	1994	Clemente et all (1998)	27	0	0.688	4.359	0.0000

Lag are included in order to account for serial correlation and t-statistics are heteroscedastic consistent for the persistence coefficient

In order to test the possibility of as change of persistence in the two sub-periods we estimated the following model proposed by Marques (2004)

$$\epsilon_t = \sum_{j=1}^{p-1} \delta_j \Delta\varepsilon_{t-j} + \sum_{j=1}^{p-1} \lambda_j D_t \Delta\varepsilon_{t-j} + \rho_1 \epsilon_{t-1} + \rho_2 D_t \epsilon_{t-1} + \varepsilon_t \qquad (13)$$

where D_t is a dummy variable which is zero for $t < T_B$ (T_B being the break time) and 1 otherwise. Parameter ρ_2 is basically used to test the change of persistence between the two periods. As heteroscedasticity across sub-periods might be a problem (even though not within sub-periods), the corresponding t-statistics for this parameter in the table 3, were computed using heteroscedastic consistent standard errors.

Table 3– Test for a change in persistence

Country	Break Points		*Lags*	$t_{\rho 2}$	Result
	T_B	Method			
Italy	1992	Chow - Perron (1989), Model B	1	1,578	No Change
	1995		0	0,8767	No Change
United Kingdom	1980	Chow - Perron (1989), Model C	1	0,618	No Change
	1992	Chow - Perron (1989), Model C	1	-0,3195	No Change
	1995		2	-2,017	No Change
Norway	1987	Chow - Perron (1989), Model B	0	1,891	Change
	1994	Clemente et all (1998)	1	-0,028	No Change

To summarize, so far the parametric estimations suggest a statistical evidence of a strong degree of persistence in the three countries, regardless the presence of non negligible differences between them. United Kingdom is the country where aggregate private consumption is more persistent and Italy seams the country where a random shock has less permanent effects on aggregate private consumption. In accordance to the model presented in section 2, these results may have to do with a higher discount factor and/or interest rate in the UK and a lower discount factor and/or interest rate in Italy.

Results also suggest that there was no statistically evidence of a change of the level of persistence between the two sub-periods of the sample for the three countries. The exception is Norway for whom the test suggests that the level of persistence has changed after 1987. However, this procedure says nothing about the direction the change.

5.2 The non-parametric measure of the degree of persistence

In this section the non-parametric approach is used in order to measure the degree of persistence. In the first place, using residuals from the estimations of the sum of autoregressive coefficients (non-unit root cases) the following results are obtained.

Table - 4

COUNTRIES	Break Points		Overall Sample			1st sub-Period			2nd sub-Period			3rd sub-Period			
	T_B	Method	T	n	γ	T	n	γ	T	n	γ	T	n	γ	
Italy	1983	Clemente et all (1998)	38	7	0.816 *	14	3	0.786 *	24	4	0.833 *				
	1992	Chow - Perron (1989), Model C	38	7	0.816 *	23	4	0.826 *	15	3	0.800 *				
	1995		38	8	0.789 *	26	6	0.769 *	12	2	0.833 *				
	1983-1995	Clemente et all (1998)	38	7	0.816 *	14	3	0.786 *	13	2	0.846 *	11	2	0.818	*
United Kingdom	1980	Chow - Perron (1989), Model C	46	11	0.761 *	18	6	0.667 *	28	5	0.821 *				
	1983	Clemente et all (1998)	46	9	0.804 *	21	6	0.714 *	25	3	0.880 *				
	1992	Chow - Perron (1989), Model C	46	6	0.870 *	30	3	0.900 *	16	3	0.813 *				
	1995		46	6	0.870 *	33	3	0.909 *	13	3	0.769 *				
	1981-1995	Clemente et all (1998)	46	10	0.783 *	19	6	0.684 *	15	2	0.867 *	12	2	0.833	*
Norway	1987	Chow - Perron (1989), Model B	27	8	0.704 *	8	3	0.625	19	5	0.737 *				
	1994	Clemente et all (1998)	27	9	0.667 *	15	3	0.800 *	12	6	0.500				
	1993-2001		27	9	0.667 *	14	2	0.857 *	9	4	0.556	6	3	0.500	

Note: * stands for the rejection of the null of $\gamma = 0{,}5$ (absence of persistence)

The non-parametric measure of persistence using the 'innovations' from models C and Clement et all (1998) confirm the presence of a strong level of persistence in United Kingdom, Italy and although more tenuous, in Norway. This means that a policy, innovation or a random shock that affects household expenditures will tend to have more permanent effects in United Kingdom and Italy than in Norway. Moreover, these shocks will tend to displace more quickly private consumption from its trend in Norway than in the outer countries. In the context of the current fiscal stimulus that are being taken by governments to tackle the economic crisis, our results suggest that Norwegian private consumption will reverse more quickly to its long-run trend than what one should expect for United Kingdom and Italian private consumption. To put it in another way, the same fiscal stimulus would be more effective in Norway than in the other two countries.

On the other hand, the non-parametric approach suggests that aggregate consumption has recently become more persistent in Italy and United Kingdom. However, for the Norwegian aggregate household expenses persistence, it is not clear whether or not there was a change in persistence or, even if there were any, its direction between the sub-period considered in the study.

The change of the inertial behaviour of aggregate consumption might be due to a change in preferences resulting in a strengthening of consumer's habits. Consumers with stronger habits tend to respond more slowly to a stimulus and thus are more reluctant to change their consumption pattern to a more green economic behaviour, for example. Moreover, as the model in section 2

shows, changes in the discount factor as well as in the interest rate may also explain changes in consumption persistence.

The literature also points out that different combinations between habits (harmful/beneficial, addition/not-addiction and addictive/multiplicative) and risk aversion (strong/weak) conditions,[11] may change the consumer willingness to substitute present for future consumption and thus the steady state capital intensity, saving rate and the economic growth rate. In particular, under certain circumstances (see Belbute & Brito, 2008) the more strength habits are the less consumers are willing to postpone their consumption and the more impact of inertia over the steady-state capital intensity. Furthermore, given the link between habit, persistence, saving and economic growth (see Shieh et al., 2000; Carrol et al., 1997,2000; Lahiri & Puhakka, 1998; and Wendner, 2002, the presence of persistence in private consumption not only affects the saving and growth rates but also might help to explain the strong evidence that economic growth significantly precedes an increase in saving.

Let us now turn to the case where we measure persistence from the cyclical component extracted from the time series with the HP-Filter and consider first the aggregate private consumption for the three countries presented at table 5.

Table 5 – Persistence in Aggregate Private Consumption: the HP- filter case

COUNTRIES	T_B	Overall Sample			1st Sub-period			2nd Sub-period			2nd Sub-period		
		T	n	γ	T	n	γ	T	n	γ	T	n	γ
Italy	1983	38	9	0,763 *	14	5	0,643	24	4	0,833 *			
	1992				23	7	0,696 *	15	2	0,867 *			
	1995				26	7	0,731 *	12	2	0,833 *			
	1983 - 1995				14	5	0,643	13	2	0,846 *	11	2	0,818 *
United Kingdom	1983	46	10	0,783 *	21	6	0,714 *	25	4	0,840 *			
	1981 - 1995				19	6	0,684 *	14	2	0,857 *	13	2	0,846 *
Norway	1987	27	6	0,778 *	8	2	0,750 *	19	4	0,789 *			
	1994				15	1	0,933 *	12	5	0,583 *			
	1993 - 2001				14	3	0,786 *	9	2	0,778 *	4	1	0,750 *

Note: * stands for the rejection of the null of $\gamma = 0{,}5$ (absence of persistence)

The non-parametric methodology confirms the presence of a significant high degree of persistence of aggregate consumption for each countries, but as opposite with the previous case, with no significant differences between them. However, results also suggest that Italian and British consumers became more reluctant in changing their consumer patterns after the breaks. Recall that during the process of ratification of the Maastricht Treaty (formally, the Treaty on European Union, TEU), the speculation by the negative result of the first Danish referendum (June 1992) and the uncertainty surrounding the French referendum (September 1992) gave rise to a speculative

[11] See, for example, Wendner (2003).

turbulence in currency markets, forcing Italian and British authorities to withdraw its currency from the European Exchange Rate Mechanism European in September 16, 1992.[12] For Norway the change of the degree of inertia between the sub-periods is neither clear nor statistically significant.

Having established that aggregate private consumption has a significant degree of inertia for the three countries and in order to assess the potential for the design of optimal public policies, it is important to measure persistence of the various categories of household's expenses. In fact, the aggregate measure of persistence hide a wide diversity of the degree of inertia between the categories of consumer's spending. This is an expectable result given that the discount factor, i.e. the concern about the future was shown to be relevant on the optimal degree of consumption persistence, being obvious that different types of consumption goods have different durabilities.

The first general conclusion is that one cannot reject the null hypothesis of presence of a statistically significant process of persistence in all nine categories of consumer's expenses, even thought for a few items this conclusion may not be true for some sub-periods before and after the break points.

Consider first the case of Italy (Table 6) and note that expenses with transportation are the most persistent (0,816) whereas housing expenses exhibits the lower degree of inertia (0,605). These two results are in line with the ones we should expect since housing mainly includes services, non-durable and semi-durables items while transport is primarily comprised by durables goods.

On the other hand, the degree of persistence did not have the same behavior in time for the nine items. In particular, housing and communications became less persistent while furnishing and health became more persistent in a permanent way. Particularly interesting is the constancy of the level of persistence displayed by alcohol and narcotics and by transportation expenses before and after the break points.

[12] The "black Wednesday" and the subsequent speculative attacks that followed until the mid of 1993 where only the results of a series of event catalyzed by the reunification of Germany in 1990. The event was unprecedented in history for the merging of a large and rich economy with a smaller economy with a much lower standard of living.

Table 6 - Persistence in Disaggregate Private Consumption: Italy

Variables	T_B	Overall Sample			1st Sub-period			2nd Sub-period		
		T	n	γ	T	n	γ	T	n	γ
Food	1995	38	11	0.711 *	26	8	0.692 *	12	3	0.7500 *
Clothing	1983	38	9	0.763 *	14	4	0.714 *	24	5	0.7917 *
Housing	1975	38	15	0.605 *	6	1	0.833 *	32	14	0.5625
Furnishing	1983	38	12	0.684 *	14	7	0.500	24	5	0.7917 *
Health	1989	38	12	0.684 *	20	9	0.550	18	3	0.8333 *
Transport	1985	38	7	0.816 *	16	3	0.813 *	22	4	0.8182 *
Communications	1996	38	13	0.658 *	27	8	0.704 *	11	5	0.5455
Education	1992	38	9	0.763 *	23	5	0.783 *	15	4	0.7333 *
Alcohol and Narcotics	1988	38	8	0.789 *	19	4	0.789 *	19	4	0.7895 *

Note: * stands for the rejection of the null of $\gamma = 0{,}5$ (absence of persistence)

In what United Kingdom is concerned, results also suggests a large range of the level of persistence across the nine categories, with clothing & shoes expanses displaying the highest degree of persistent (0,804) while furnishing expenditures respond more seldom to a random shock (0,652).

On the other hand, when we consider the sub-periods, results show that it is not possible to reject the null hypothesis of absence of persistence for clothing, furnishings, health, communications, education and alcohol and narcotics. Moreover, the "dynamic" of persistence between sub-periods suggests that for four categories of household's expenses, there was a clear reduction of the degree of persistence (clothing, health, education and alcohol) whereas the remainder items did not register any significant variation.

Table 7 - Persistence in Disaggregate Private Consumption: United Kingdom

Variables	T_B	Overall Sample			1st Sub-period			2nd Sub-period		
		T	n	γ	T	n	γ	T	n	γ
Food	1984	46	12	0.739 *	22	6	0.727 *	24	5	0.7917 *
Clothing	1997	46	9	0.804 *	35	7	0.800 *	11	6	0.4545
Housing & Utilities	1983	46	14	0.696 *	21	6	0.714 *	25	7	0.7200 *
Furnishing	1991	46	16	0.652 *	29	12	0.586	17	8	0.5294
Health	1978	46	14	0.696 *	16	6	0.625	30	9	0.7000 *
Transport	1981	46	14	0.696 *	19	6	0.684 *	27	10	0.6296 *
Communications	1986	46	13	0.717 *	24	10	0.583	22	11	0.5000
Education	1987	46	12	0.739 *	25	4	0.840 *	21	12	0.4286
Alcohol & Narcotics	1978	46	12	0.739 *	16	5	0.688 *	30	13	0.5667

Note: * stands for the rejection of the null of $\gamma = 0{,}5$ (absence of persistence)

Finally, the case of Norway also confirms the presence of different degrees of persistence between all categories of household's expenses. In particular, transportation is the component of the

Norwegian aggregate private consumption that more slowly responds to random changes, as it also happens in Italy. Moreover, it is interesting to notice that the least persistent components of Norwegian household's consumption are the expenses with health and with alcohol and narcotics.

On the other hand, as in Britain, the results also suggest a wide number of categories for which one could not reject the null hypothesis of absence of persistence, in several sub-periods. Moreover, Norway is also the country with fewer changes in the degree of persistence before and after the breaks. Only health (which has become more inertial) and education and alcohol and narcotics (whose changes became less permanent) have had statistically significant changes in their degree of persistence.

Table 8 - Persistence in Disaggregate Private Consumption: Norway

Variables	T_B	Overall Sample			1st Sub-period			2nd Sub-period		
		T	n	γ	T	n	γ	T	n	γ
Food	1998	27	8	0.704 *	19	5	0.737 *	8	3	0.6250
Clothing	2001	27	6	0.778 *	22	5	0.773 *	5	1	0.8000 *
Housing & Utilities	1998	27	6	0.778 *	19	3	0.842 *	8	3	0.6250
Furnishing	1994	27	8	0.704 *	15	3	0.800 *	12	5	0.5833
Health	1998	27	7	0.741 *	19	5	0.737 *	8	2	0.7500 *
Transport	1994	27	5	0.815 *	15	2	0.867 *	12	3	0.7500 *
Communications	1997	27	6	0.778 *	18	3	0.833 *	9	3	0.6667
Education	1994	27	10	0.630 *	15	2	0.867 *	12	8	0.3333
Alcohol & Narcotics	1983	27	10	0.630 *	4	1	0.750	23	9	0.6087

Note: * stands for the rejection of the null of $\gamma = 0{,}5$ (absence of persistence)

6. Conclusion

Our results show that we cannot reject the presence of a significant process of persistence in aggregate and disaggregate consumption in the three countries, even though each one displaying different levels of persistence. Clearly, this is in accordance to the theoretically-expected results as, for instance, those presented further to the model of optimal consumption in section 2. Being the case that negligible differences in the interest rates between the three countries exist, those results agree with different cultural aspects such as the time horizon of consumers.

Furthermore, the degree of persistence is even different when we consider disaggregate private consumption. In particular, durables (furnishing and housing & utilities) display a lower degree of persistence when compared with non-durables. This is line with the different nature of these two categories of expenses. With durables spending and "consumption" (consumption services and enjoyment) does not occur simultaneously. Spending occurs in one moment and is reflected in data

whereas consumption is staggered and it is not included in data. Like investment goods, durables have a more distinct pro-cyclical behavior than non durables.

Plainly, these results are imperative from a policy point of view. First of all, persistence in consumption does exist and cannot be ignored, whether the goal is to stabilize the level of output via consumption or to burst output via long-lasting increases in consumption. Being the case that cultural differences are not easily changed, a possible instrument is the interest rate. Our results do show that a decrease in the interest rates, in order to boost investment, may also lead to non desirables results from the viewpoint of consumption, in particular for the durables categories

In terms of future work, it is our intention to consider other countries allowing for the accounting of other characteristics that make them different. Being obviously difficult to measure the discount factor, a promising avenue seems to include aspects related to the interest rate as well as to the degree of aversion to risk.

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Appendix – Unit Roots tests

Table 1A – DF-GLS Unit root tests – Italy

VARIABLE	DET	Lags	t_c	t_τ	BIC
Aggregate Consumption	Constant and Trend	1	-2,150	-3,283	18,241
Food	Constant and Trend	1	-1,410	-3,283	14,244
Clothing	Constant	1	0,613	-2,417	14,818
Housing	Constant and Trend	1	-0,305	-3,348	14,917
Furnishing	Constant and Trend	4	-0,765	-3,081	14,485
Health	Constant and Trend	1	-1,481	-3,348	12,834
Transport	Constant	1	0,987	-2,417	15,954
Communications	Constant	3	0,019	-2,325	12,776
Education	Constant	1	-0,268	-2,417	10,4336
Alcohol and Narcotics	Constant	1	-1,679	-2,417	12,012

Table 2A – DF-GLS Unit root tests – United Kingdom

VARIABLES	DET	Lags	t_c	t_τ	BIC
Aggregate Consumption	Constant and Trend	1	-1,775	-3,50	20,896
Food	Constant	0	0,175	-2,93	16,478
Clothing	Constant	1	2,431	-2,93	15,778
Housing	Constant and Trend	0	-11,498	-3,50	17,383
Furnishing	Constant and Trend	1	-2,190	-3,50	16,505
Health	Constant and Trend	1	-2,757	-3,50	13,857
Transport	Constant and Trend	1	-2,430	-3,50	18,480
Communications	Constant	1	2,268	-2,93	14,519
Education	Constant and Trend	1	-1,990	-3,50	14,683
Alcohol and Narcotics	Constant and Trend	0	-6,119	-3,50	16,766

Table 3A – DF-GLS Unit root tests – Norway

VARIABLE	DET	Lags	t_c	t_τ	BIC
Aggregate Consumption	Constant and Trend	1	-0,560	-3,485	18,056
Food	Constant and Trend	1	-1,527	-3,485	13,889
Clothing	Constant	1	-0,126	-2,485	14,060
Housing	Constant and Trend	2	-1,166	-3,485	14,255
Furnishing	Constant and Trend	1	-0,248	-3,485	13,937
Health	Constant	1	0,427	-2,485	12,529
Transport	Constant and Trend	1	-1,112	-3,485	16,714
Communications	Constant and Trend	1	-0,484	-3,485	14,381
Education	Constant	1	-0,445	-2,485	10,997
Alcohol and Narcotics	Constant	7	-0,271	-2,485	13,771

Table 4A – Unit root t-tests accommodating for the presence of a structural break/outliers

Country	Method	TB	Lag	λ	ρ	τ_t	t_c	
Italy	Clemente et all (1998) - Innovative Outleirs	1983				-1,765	-4,270	
	Known break, Perron (1989) - Model B	1992	2	0,61	0,728	6,996	-3,950	*
	Chow, Perron (1989) - Model B	1995	2	0,68	0,510	3,925	-3,860	*
	Clemente et all (1998) - Innovative Outleirs	1983-1995				-1,575	-5,490	
United Kingdom	Chow, Perron (1989) - Model C	1980	1	0,37	0,790	8,807	-4,230	*
	Clemente et all (1998) - Innovative Outleirs	1983				-0,124	-4,270	
	Chow, Perron (1989) - Model C	1992	1	0,63	0,784	10,750	4,080	*
		1995	1	0,70	0,776	10,240	-3,960	*
	Clemente et all (1998) - Innovative Outleirs	1981-1995				-3,220	-5,490	
Norway	Chow, Perron (1989) - Model B	1987	0	0,26	0,791	6,816	-3,850	*
	Clemente et all (1998) - Innovative Outleirs	1994				4,648	-4,270	*
		1993-2001				-0,699	-5,490	